LOCAL VARIATIONS IN VENUS TESSERAE IDENTIFIED BY BACKSCATTER VARIATIONS.

J. L. Whitten[1] and B. A. Campbell[2], [1]Dept. Earth and Environmental Sciences, Tulane University (6823 St. Charles Ave., New Orleans, LA 70118; jwhitten1@tulane.edu), [2]Smithsonian Institution, National Air and Space Museum, Center for Earth and Planetary Studies, Washington DC, 200013.

Introduction: Tesserae only cover 7% of the surface of Venus [1], but these materials represent the oldest [2] rock record on the surface and may preserve evidence of different earlier climate conditions on Venus. Generally, tesserae are regions of high standing topography. Tesserae are identified by their complex morphology, which involves at least two sets of intersecting tectonic structures (e.g., graben, ridges, fractures) [3]. Their high degree of deformation, which created areas of increased surface roughness, leads to a radar-bright appearance of tesserae in the Magellan SAR data and often enhanced Fresnel reflectivity.

Despite the importance of the tesserae for understanding Venus prior to ~500 Ma, its surface properties are not well constrained. The range in radar brightness, or backscatter coefficient, across the tesserae has not been quantified in detail, and could provide important information about the distribution of crater ejecta or locally-derived regolith, as well as inherent differences in the original tessera materials.

Here, we analyze the Magellan synthetic aperture radar (SAR) and Earth-based radar datasets to more specifically constrain the radar properties of tesserae. The range in radar brightness across the tesserae has not been quantified, and could provide important information about the distribution of crater ejecta or locally-derived regolith, as well as inherent differences in original tessera materials. This is a first and fundamental step to addressing the much larger questions about tesserae, including their composition and formation mechanism(s).

Methodology: We quantify radar brightness variations across tesserae by calculating the backscatter coefficient [4] of backslopes (slopes that are facing away from the Magellan spacecraft) using Magellan SAR orbital datasets. Magellan SAR data (12.6-cm) have a linear HH polarization and are sensitive to slopes on the order of tens to hundreds of meters. The pattern of backscatter coefficient variations in each tessera deposit are compared with the presence of various geologic landforms, such as impact craters and volcanic structures. Fine-grained particles in distal impact crater ejecta or erupted during volcanic activity can modify surface roughness [e.g., 5, 6]. For example, these particles can smooth the surface by infilling small-scale topographic lows and cracks. Identifying where impact craters or volcanic eruptions have modified the radar surface properties of tessera will enable

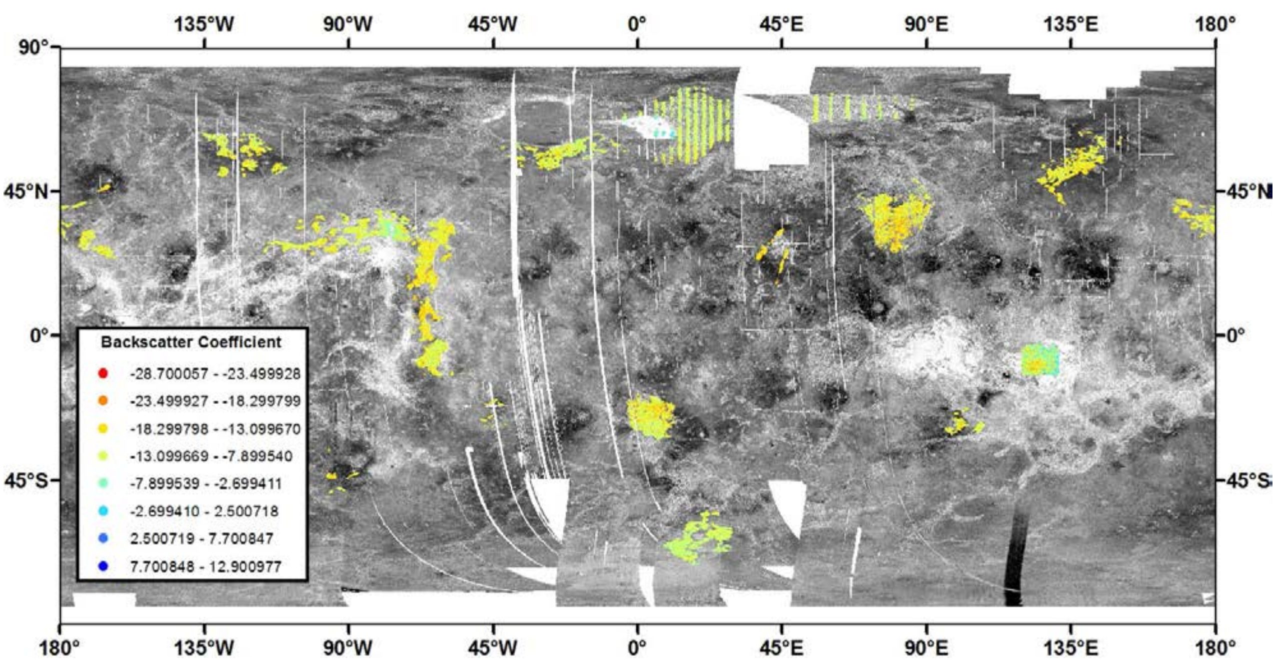

Figure 1. Distribution of tesserae backscatter coefficient values (colorful dots) across Venus. Note variations between and within different tesserae (e.g., Sudenitsa, Alpha, Cocomama, Tellus). Base map: Magellan SAR left and right look data.

identification of more "pristine" regions to determine natural variations in tessera material properties.

Results and Discussion: The backscatter coefficient varies across the 21 tesserae measured, with values from -28 dB to almost 13 dB. There are substantial backscatter coefficient variations both within and between tesserae (Fig. 1). Correlations between backscatter coefficient and the expected location of crater ejecta exist [7], where ejecta regions have lower backscatter coefficient values. For example, the fine-grained ejecta from Stuart crater smooths the surface of eastern Alpha Regio [5]. Our analysis indicates that crater ejecta is preserved in the rougher tessera longer than on adjacent low-lying plains (>35±15 Ma). Lower backslope coefficient values occur in Tellus Tessera, but not in the adjacent plains [6].

While no correlations between backscatter and volcanic constructs have been identified, there is evidence from northern Nedoyla Tesserae that differences in tesserae morphology and/or local elevation differences are associated with variations in backscatter coefficient. These backscatter coefficient variations may be related to the inherent tesserae properties, rather than to the properties of materials emplaced as airfall from another geologic process.

Magellan data show that the tesserae vary substantially in their radar properties, both within an individual tessera and also between tesserae. Some, but not all, of these variations can be attributed to local geologic landforms and their associated processes, such as impact craters. These remaining backscatter coefficient variations suggest that the original tessera materials varied in some way (composition, grain size, formation process, local geologic processes) to cause such different expressions of radar properties.

The results of this study provide tantalizing information about the geologic history of Venus preserved in the tesserae. To fully constrain tesserae composition additional datasets are needed from future missions.

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